Abstract

The invention proceeds from a tube motor with an electric motor drive with a drive shaft located in a gear box, with a reducing gear with a driven shaft located in a gear box and coupled with the drive shaft via a gear input shaft and, for rotary securing of the driven shaft especially when the drive is disengaged, with a wrap-spring brake with a wrap spring working against the gear box, while the drive shaft and the gear input shaft work together with the wrap spring.

The invention is characterized in that, located between the wrap spring and the gear housing and secured against torsion, is an annular element, which diverts a moment introduced by the driven shaft into the gear housing.

Description

The invention pertains to a tube motor with an electric motor drive with a drive shaft located in a gear housing, with a reducing gear with a driven shaft located in a gear box and coupled with the drive shaft via a gear input shaft, and, for rotary securing of the driven shaft especially when the drive is disengaged, with a wrap-spring brake with a wrap spring working against the gear housing, while the drive shaft and the gear input shaft work together with the wrap spring.

In particular, such tube motors are used for the electric drive of a winding shaft of a roller shutter, a slatted blind, an awning, a roller curtain, a roller door, a garage door and the like. In the case of such an arrangement, provision must be made that the driven shaft of the tube motor driving the winding shaft is secured against torsion when the drive is disengaged. In this way it is avoided that the roller shutter, e.g., does not under its own weight unwind the winding shaft coupled with the driven shaft of the tube motor and independently close the shutter. For securing the driven shaft, a reducing gear for a tube motor with a wrap-spring brake is known, e.g., from EP

0,810,347 A1. The wrap spring of such a wrap-spring brake, due to its tension-release effort, positively couples the driven shaft with the gear housing when the drive shaft is not turning.

When the drive shaft is rotated by the drive, the wrap spring is contracted, whereupon the positive coupling is released and a rotation of the driven shaft by the drive becomes possible.The direct coupling of the wrap spring with the gear housing has various disadvantages, For one, due to the tension-release effort of the wrap spring, installation of the wrap spring is possible only with difficulty, e.g., only with the use of auxiliary means. Here the wrap spring must be coiled together or drawn together against its tension-release effort, in order to insert it into the offset provided therefor in the gear housing. A further disadvantage is the fact that in its installed state the wrap spring, due to its tension-release effort, presses radially against the inner side of the gear housing.

In order to be able to resist these radial forces, the gear housing must have a commensurate wall thickness or be made of a material capable of compensating the forces, especially metal. This results in the disadvantage that the gear housing cannot be dimensionally conceived as small as desired or that, due to the material used, is unnecessarily heavy. Accordingly, the objective of the present invention is to specify a tube motor with a reducing gear, which on the one hand can be installed in a simple manner and on the other hand can be designed so as to be very space-saving. In realization of this objective, a tube motor of the type described in the preamble is proposed, which for an annular element positioned free of torsion between the wrap spring and the gear housing, which diverts a moment introduced by the driven shaft into the gear housing. The invention then has the advantage that the wrap spring can be preinstalled in the annular element, so that the final installation of the tube motor and especially the reducing gear is possible in a simple manner. The tension-release effort of the wrap spring does not in any way interfere with the final installation of the tube motor.

The invention has the further advantage that, as a result of the annular element between the wrap spring and the gear housing, none of the radial forces resulting from the spring tension of the wrap spring act on the gear housing.The radial forces introduced by the wrap spring are fully absorbed by the annular element. Thus a relatively weak configuration of the gear housing is made possible. In a convenient manner, the gear housing can be made of plastic, especially as a molded part. In an especially advantageous embodiment form of the invention, provision is made for the inner side of the gear housing to have an inner toothing and the jacket surface of the annular element facing toward the inner side of the gear housing to have a matching outer toothing. By virtue of an engagement of the outer toothing of the annular element and the inner toothing of the inside of the gear housing, the annular element can be mounted on the gear housing free of torsion.

In another embodiment of the invention, the annular element can be securely seated in the gear housing. In this manner, especially during the installation of the tube motor, the annular element can be precluded from falling out of the gear housing. In another variant of the invention, provision is made for the annular element to have locking hooks or indentations on its periphery, which can then engage with locking hooks or indentations on the inner side of the gear housing.
Such locking hooks or indentations provide a good anchoring of the annular element in the gear housing and can also be realized in a simple and cost-favorable manner. In particular, the annular element can be provided with recesses as reinforcement of the spring action of a locking hook, so as to preclude a plastic deformation of the annular element.

In the case of another embodiment form of the invention, the reducing gear has a planetary gear drive, while the planetary gear drive has a sun wheel as its gear input shaft. Precisely by way of a planetary gear drive is a very high reduction with slight frictional losses possible. Here the sun wheel as the gear input shaft works directly together with the driven shaft and the wrap-spring brake.

In such a configuration of the invention, the planetary gear drive has planets that roll off on the inner toothing of the inner side of the gear housing. Then the inner

side of the gear housing has a double function. On the one hand the planets roll off on it and on the other hand it serves to prevent the torsion of the annular element.

Another embodiment form of the invention is characterized in that side of the sun wheel facing the wrap spring has several, especially two, semicircular, curved lands, around which the wrap spring is positioned. This provides the coupling of the sun wheel with the wrap spring.

Advantageously, a land has a shoulder for receiving the one end of the wrap spring oriented on the longitudinal axis of the tube motor. This opposes a possible clamped binding of the one end of the wrap spring.

Another embodiment of the invention proposes that the side of the driven shaft facing toward the wrap spring have several, especially two, engagement lands, which fit with a definite play into the free spaces between the lands of the sun wheel. The defined play between the lands and the engagement lands is necessary to make possible a turning together and therefore also a disengagement of the positive closure between the wrap spring and the annular element.

Another configuration of the invention provides that one engagement land have a shoulder for receiving the other end of the wrap spring oriented on the longitudinal axis of the tube motor. This then prevents a clamped binding of the other end of the wrap spring.

In an advantageous manner provision can be made according to the invention for the sun wheel to have a core. Especially when the sun wheel is made of plastic, a core can increase the torsion transferable by the sun wheel.

Such a core advantageously has a hexagonal cross section or a Torx cross section. It is precisely these cross sections that are well suited for transferring high moments of torsion.

In the case of another, also very advantageous embodiment of the invention, a toothed wheel-work is present between the drive and the drive shaft. With such a prepositioned

wheel-work, the reduction of the tube motor can be significantly improved. With the combination of the toothed wheel-work with the planetary gear drive, reduction ratios of 1:40 can be realized. In such a configuration, the wrap spring does no work

directly on the driven shaft but rather between the toothed wheel-work and, e.g., the planetary gear drive. With the reduction of the wheel-work lesser forces are applied to the wrap spring, so that the wrap spring can be advantageously dimensioned smaller.

Here provision can be especially made for an obliquely toothed pinion mounted directly on the drive, which drives at least one cogwheel running axially to the drive shaft. This pinion can advantageously have a diameter of a few millimeters and an extremely oblique toothing.In further refinement of the toothed wheel-work, the one minimal cogwheel is rotationally mounted on a wheel-work axis, while this wheel-work axis is located on the side of the gear box facing toward the wrap-spring brake. Such an arrangement of the wheel-work axis is advisable since the position of the gear box in relation to the pinion is unalterable.

In order to achieve greater reduction of the toothed wheel-work, the one minimal cogwheel has a second reducing stage, which is designed as a pinion and drives a ring gear. Because of the very restricted space conditions in a tube motor, the use of a ring gear as an additional reducing stage is advisable.

In an especially advantageous embodiment form of the toothed wheel-work, two symmetrically arranged cogwheels are present, each of which has a second reducing stage and drives a common ring gear. With such a symmetrical configuration, undesirable forces are especially well compensated.

In yet another embodiment of the invention, the side of the ring gear remote from the drive conveniently forms the drive shaft working together with the wrap-spring brake and the drive input shaft, especially the sun wheel. A tube motor with very favorable and functionally safe characteristics is made available thereby.

Furthermore, provision can be advantageously made according to the invention for the individual components of the tube motor to be locked together for the final assembly of the tube motor. Then the assembly of the tube motor can be accomplished without special tools, which is also favorable in the event of a disassembly of the tube motor. This works against the individual components of the tube motor simply falling out.

Additional advantageous embodiments and details of the invention are set forth in the following description, in which is described in greater detail and explained with references to the embodiment examples illustrated in the appended drawings. Depicted are:

Figure 1, a longitudinal section through a tube motor according to the invention;

Figure 2, the planetary reducing gear with wrap-spring brake of the tube motor according to

Figure 1;

Figure 3 and Figure 4, the wrap spring with the annular element in different views;

Figures 5-7, the ring gear of the tube motor according to Figure 1 in various views, and

Figures 8-12, various views of the sun wheel of the tube motor according to Figure 1.Figure 1 shows a tube motor (1) with an electric motor drive (3) in a gear box (2). This drive (3) has brushes (4) in contact with a collector (7). Also clearly shown is a drive shaft (8), on which a rotor (9) is mounted. Present on the free end of the drive shaft (8) is a pinion (12) with oblique toothing. Driven by the pinion (12) are two symmetrically arranged cogwheels (13), which run axially to the drive shaft (8). Only one cogwheel (13) can be seen in Figure 1, since the Figure has a sectioning line in the area of the second cogwheel, in which the second cogwheel does not lie.

The cogwheels (13) are rotationally mounted on cogwheel axes (14). The cogwheel axes (14) are in turn mounted on a gear retainer (17) located on the open face of the gear box (2) facing toward pinion (12). The gear retainer (17) then forms the frontal part of the gear box (2) and is nondetachably joined to the gear box (2). Each of the cogwheels (13) has two reducing stages, namely one reducing stage (18) that meshes with the pinion (12) and a second reducing stage (19), which is designed as an interior pinion and drives a ring gear (22). The toothed wheel-work located behind the drive shaft (8) of the drive (3) is covered by a tube-like cover part (23) and screwed together with the gear retainer (17) by means of a fastening screw (24).The

ring gear (22) thus driven then works together with a wrap-spring brake (27) and with a sun wheel (28) of a reducing gear, namely a planetary gear (29) with a driven shaft (30), in such a way that driven shaft (30) is secured against rotation by means of the wrap-spring brake (27) when the drive (3) is disengaged. Figure 2 depicts the reducing gear, namely the planetary gear (21), in an enlarged view. Clearly shown are the ring gear (22) and the sun wheel (28) working together with the ring gear (22). Located between the ring gear (22) and th4e sun wheel (28) is the wrap-spring brake (27). The wrap-spring brake (27) has a wrap spring (32 and an annular element (34) located between a gear box (33) and the wrap spring (32) mounted on the gear box (33) so as to be free of torsion.

The wrap spring (32) and the annular element (34) are shown as individual parts in Figures 3 and 4 respectively. In can be clearly seen that an outer toothing is provided on the jacket surface of the annular element (34). In Figure 3, in which the annular element (34) is depicted in frontal view, it can also be seen that the wrap spring (32) has two free ends, which are oriented in the direction of the longitudinal axis of the annular element (34) or the overall tube motor (1).

The peripheral area of the annular element (33) has two recesses (37) that are provided for receiving locking hooks and should make possible a locking of the annular element (34) on the gear box (33). In Figure 4 as well, which depicts a cut along the line A/A in Figure 3, a recess (37) is clearly evident. Due to the tension-release tendency of the wrap spring (32), the wrap spring (32) presses radially against the inside of the annular element (34). Then a turning of the wrap spring (32) in relation to the annular element (34) is possible only when the wrap spring (32) is turned against its tension-release tendency.

Shown in Figures 5, 6 and 7 is the ring gear (22). The ring gear (22) has an inner toothing (38), which meshes with the reducing stage (19) of the cogwheels (13). I Figure 6, in which a top view of the ring gear (22) is depicted, two engagement lands (39) can be clearly seen. These engagement lands (39) are provided for engaging the free ends of the wrap spring (32). By virtue of this engagement of the free ends of the wrap spring (32) the wrap spring (32) is compressed, so that it is

possible for the wrap spring (32) to rotate in relation to the rotationally stationary annular element (34). Here the one engagement element (39) has a shoulder (42) for receiving the one end of the wrap spring (32). In Figure 7, which depicts a side view of the ring gear (22), this shoulder (42) is also clearly shown. Also shown in Figure 5 are locking hooks *43), by means of which the ring gear (22) can be locked onto the sun wheel (28). This particularly prevents the ring gear (22) from falling out of the sun wheel (28). It is evident in Figure 8 that the sun wheel (28) has two component sections, namely a toothed section (44) with toothing and a coupling section (47) working together with the wrap-spring brake (27). The side of the sun wheel (28) facing toward the wrap spring (32) or the coupling section (47) has two lands (48) that are circularly curved when viewed in cross section, which are also clearly evident in Figure 9, which is a frontal view of the sun wheel (28), as well as in Figures 10 and 11, which depict the two views (X) and (Y) according to Figure 9. In the assembled state of the tube motor, as is especially depicted in Figure 2, the wrap spring (32) is positioned around the two curved lands (48). One of the lands (48) has a shoulder (49) for receiving the other free end of the wrap spring (32). In the assembled state of the tube motor (1), the two engagement lands (39) engage in the free spaces between the lands (48) of the coupling section (47) of the sun wheel (28). However, a certain play, i.e., a defined additional free space, must be provided between the lAnds (48) and the engagement lands (39) in order to permit a rotary compression of the wrap spring (32) over the engagement lands (39). As can be seen in Figure 12, which depicts a cut along the line B/B in Figure 8, the sun wheel (28) has a core (52) along its axis. The core (52) is preferably made of steel and has a Torx cross section, which matches the outer toothing of the toothed section (44). This makes it possible for the transfer of very high moments of torsion despite the lesser dimensioning of the sun wheel (28), which is preferably made of plastic.

Also clearly shown in Figures 8 and 9 are locking indentations (53), in which the locking hooks (43) of the ring gear (22) can engage. As an installation aid, the sun wheel (28) has an assembly land (54), which is clearly evident especially in Figure 9.

For installing the ring gear (22) and the sun wheel (28), the assembly land (54) is inserted into an assembly groove (57) provided for this purpose on the ring gear (22). Assurance is given thereby that the tube motor (1) is can be assembled so as to be functionally safe.

As shown in Figure 2, the sun wheel (28) drives three planets (58), although only one planet (58) is depicted in the section according to Figure 2. The planets (58) roll off on an inner toothing (59), which is present on the inner side of the gear box (33). This inner toothing (59) extends from the side of the gear box (33) facing toward the ring gear (22) to a shoulder (62), which axially bears the driven shaft (33). The outer toothing of the annular element (34) matches the inner toothing (59), so that the annular element (34) can be inserted for installation in the toothing (59).

For the assembly of the planetary gear drive (29) shown in Figure 2 and the cover part (23), the gear box (33) has a locking hook (63), which can engage in the locking indentations (64) on the cover part (23), which are shown in Figure 1.When the drive (3) is disengaged, a moment of torsion introduced via the driven shaft (3) is transferred by the planetary gear drive (29) to the sun wheel (28). As a result of the working together of the coupling section (47) of the sun wheel (28) and the wrap spring (32) located in the annular element (34), the wrap spring (32) is expanded and the positive closure between the wrap spring (32) and the annular element (34) is intensified. The radially applied forces are then absorbed by the annular element (34).

The transferred moment of torsion is diverted into the gear box (33) via the outer toothing of the annular element (34) and the inner toothing (59) of the gear box (33). As clearly shown in Figure 1 and Figure 2, the section of the gear box (33) encompassing the annular element (34) can be dimensioned very thin. Conveniently, the gear box (33) is screwed together with, e.g., a tube encompassing the tube motor by means of a fastening screw passing through a screw bore (67).

All of the characteristics presented in the description, the following claims and the appended drawings can have inventive merit both individually and in any given combination.